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BALL GAME RACKET

This invention refers to a ball game racket, especially a tennis racket, comprising a racket head formed by a tension frame with stringing and by a handle element connected to the tension frame, for example by means of a core, and formed by a handle shaft or a racket neck and a handle, as well attenuating means on at least one area of the racket frame.

Ball game rackets, especially designed as tennis rackets, are known in most different varieties.

Furthermore, hydraulic mediums or liquids are known the viscosity of which can be altered by an electric or electromagnetic field in a controlled manner; the use of such liquids is used in connection with ski bindings (DE 195 17 417 A1).

It is an object of this invention to provide a ball game racket the characteristics of which can be altered dynamically, for example by using the racket dependent on forces exerted upon the racket.

This object is solved by attenuating means including an attenuation fluid the viscosity of which is controllable by an electric and/or a magnetic field, and by electric control means for altering the viscosity of the attenuation liquid.

In the following this invention is explained in connection with embodiments by referring to the drawings. The drawings show:

Fig. 1 in a simplified representation and in plan view a ball game racket according to the invention designed as a tennis racket;

Fig. 2 is a cross-section along line I - I of Fig. 1 through the racket head or the tension frame;

Fig. 3 is a basic representation of a circuit for adjusting the stiffness of the racket head tensioning.

The tennis racket shown in the figures and generally marked by 1 comprises basically a tension frame 2 forming the racket head, the stringing 3 which has a plurality of crossing string lengths 4' or strings 4, and the racket neck or racket handle shaft 6 joining the tension frame or it's profile 2' (Fig. 2) across a core 5; the racket handle 7 joins the racket neck.

The tension frame profile 2', the core 5 which is formed by two diverging webs or arms 5' starting at the handle shaft 6, as well the handle shaft 6 form a one-piece racket frame, which according to the shown embodiment is designed as a hollow profile entirely closed from outside, or as a closed hollow frame made of suitable material, f.e. fiber reinforced plastic material forming a hollow profile which across its entire extension is closed outwardly.

As shown in Fig. 2 the tension frame 2 or the tension frame profile 2' in view of the stringing 3 is provided with an outer support profile 8 arranged outside thereof, which support profile in the shown embodiment embraces the tension frame profile 2' over its entire length between the arms 5' of the core 5. The support profile 8 is formed symmetrically in view of a centre plane which also is the stringing plane BE, and basically comprises a hood- or wing-type profile section 9, which is open towards the stringing 3; the profile section 9 with its both edges 9' rests sealingly upon the frame profile 2' formed by the closed hollow profile.

The wing-type curved profile section 9 within the area of the stringing plane BE is formed concavely on its outer surface opposite to the stringing 3, and forms a

groove-type recess 10 embracing the racket head or tension frame 2 at the outside area. At both sides of said recess 10 the profile section 9 within the cross-section of Fig. 2 is curved in a substantially convex manner at its outer surface so that on both sides of the stringing plane BE two sections are provided which in cross-section of Fig. 2 form a concave recess 11 at the inner side facing the stringing which recess also extends across the entire length of the supporting profile 8 parallel to recess 10. In addition, the supporting profile 9 in addition has sleeves or eyelets formed thereon, which extend beyond that side of the profile section 9 facing the frame 2', and which are passed through bores 13 and 14 of the frame profile 2'. The eyelets 12 themselves have bores 15 through which the strings 3' are passed in a manner known in the field of stringing tennis rackets so that the corresponding string 4 extends outwardly in an assumed direction through the bore 15 of an eyelet 12, then extends within the recess 10 along the outer surface of the tension frame, and finally extends through a further eyelet 12 or it's bore 15 back again to the interior, etc. With eyelets 12 the supporting profile 8 to a certain extent is movable in the direction of the axis of the eyelets 12 in view of the frame profile 2'. The supporting profile 8 is preferably made of fiber reinforced plastics material in such a manner that it or alternatively the profile section 9 thereof acts as a blade spring, and with a racket with stringing exerts the springy force onto the strings 4 required for the stringing.

With the shown embodiment the frame profile 2' at the outer surface facing the profile section 9 is provided with a channel-type recess 16 at both sides of the stringing plane BE and distant thereof; one recess each is arranged opposite a recess 11. Within the spaces formed by said recesses 11 and 16 attenuating elements 17 are provided, which are in contect with the frame profile and the profile section 9. With the shown embodiment said attenuating elements 17 are formed by elastic hoses closed at both ends and extending across the major length of the racket head between the webs 5', namely parallel to plane BE. The hoses 18 each are made of permanent elastic material, for example of elastic plastics material, and are provided

with a plurality of sections 18' which are reduced in cross-section and accordingly are operating as nozzles so that in longitudinal direction each attenuating element 17 is followed by a hose section 18'' with a large inner cross-section and a hose section 18' with reduced cross-section in an alternating manner. The attenuating elements 17 or the hoses thereof each are filled with liquid attenuation means, f.e. with a hydraulic medium or a liquid the viscosity of which can be altered by an electric and/or a magnetic field.

Liquids or media (dispersions/suspensions) the viscosity of which can be altered by means of an electric or a magnetic field, and which can also be described as electro-rheological resp. magneto-rheological liquids, are known per se and for example are distributed by Fludicon GmbH, Landwehrstraße 50, 64293 Darmstadt, Germany. Furthermore, other suitable liquids or media are described among others within EP 0 845 790 A1 and US 4 992 190, EP 0 406 692, JP 41 98 297 and US 5 354 488.

The hose sections 18' are provided with electrodes 19, which when applying an electrical voltage generate an electrical field in the corresponding hose section 18'. The electrodes 19 at the hose sections 18' are connected with triggering electronic means 20 which dependent on the signal of one or several sensors 21 control the voltage applied between the electrodes 19, and thus the viscosity of the attenuating liquid flowing through the hose section 18' so that by means of the triggering electronic means 20 the throttle effect within sections 18' is controlled dependent on the signal of at least one sensor 21.

In detail, the construction of the shown embodiment is designed so that for example when a ball hits an area of the racket surface and in view of the increased mechanical tension within the strings 4 at this location the supporting profile 8 under elastic deformation of the profile section 9 is moved towards the frame profile 2' and in this way attenuating liquid is displaced from that part of the attenuating elements 17, as shown in Fig. 3 by arrows K. The displaced attenuating liquid then is distributed across the remaining length of the corresponding attenuating element by elastically deforming the corresponding hose 18, and flows

through a hose section 18' acting as a throttle. Depending on the voltage applied to the electrodes 19 and the change effected thereby, the viscosity of the attenuating liquid acts upon the corresponding hose section 18' more or less as a throttle so that the characteristics of the tennis racket 1 can be dynamically controlled dependent on the signal of the at least one sensor 21.

Preferably, several sensors 21 are provided, for example in such a way that when a ball hits an area of the racket surface in this area or in other areas of the racket surface the attenuation effect on the racket is increased by increasing the viscosity of the attentuating liquid, or vice versa the attenuation effect is reduced by reducing the viscosity of the attenuating liquid.

The sensor(s) 21 preferably are sensors operating according to the piezo effect, which dependent on the deformation of the frame profile 2' or the support profile 8 produces an electric signal. Said sensors then are provided accordingly at the frame profile 2' or at a support profile 8. Contrary thereto the sensor(s) 21 can be designed so that the deformation of the support profile 8 relative to the tension frame profile 2' can be determined and a signal can be delivered, which is dependent therefrom. Other types of sensors 21 can be used, too.

The sensor(s) 21, moreover, can be arranged on the racket handle or for example between the racket handle 7 and the racket head in such a manner that the signal generated by said sensors is dependent on the deformation or torsion of the racket frame or the racket core 5.

Basically, it is possible to trigger the pairs of electrodes 19 provided on the hose sections 18' individually or in groups by the control means 20, namely by signals of one or several sensors, for example by using available triggering patterns determined within the electronic means 20 or the memories thereof.

Furthermore, it is possible to provide adjustment means instead of the sensor 21 or in addition thereto, by means of which the attenuating action or stiffness of the damping elements 17 can be adjusted manually.

Arranging the electronic means 20 the possibly required voltage supply in the form of at least one battery, preferably a reloadable battery, the adjustment means 22 and possibly also indication means 23 giving information concerning the condition of the system can be arranged within the racket handle 7.

Above, there has been described that influencing the viscosity of the attenuating liquid is performed by means of an electric field. Basically, there is also the possibility to use a magnetic field instead of an electric field for acting upon the attenuating liquid. In this case, for example at the hose sections 18' instead of electrodes 19 at least one magnetic coil each is used, which embraces the corresponding section 18' and which is triggered by the control means 20.

Above, there has also been described that the attenuating elements 17 are hoses. Generally, there is the possibility to provide individual, closed, for example cushion-type elements which are filled with an attenuating liquid the viscosity of which is controlled by means of an electric or a magnetic field.

Contrary to the described structure there is also the possibility to provide chambers or closed spaces for receiving the liquid altering the viscosity within the racket or racket head frame in such a manner that any deformation of the racket frame or racket head frame results in a flow of said liquid. By altering the viscosity of the liquid the flow thereof can be promoted in a controlled manner or can be reduced so that then the deformability of the racket head frame or the racket frame altogether can be controlled.

The invention has been described in connection with various embodiments. The expert realizes that numerous further alterations and revisions will be possible without leaving the scope of invention.

List of Reference Numerals:

1	tennis racket
2	tension frame
2′	tension frame profile
3	stringing
4	string
4′	string length
5	core
5′	arm
6	handle shaft
7	racket handle
8	support profile
9	profile section
10, 11	recess
12	eyelet
13, 14	bore
15	bore
16	recess
17	attenuating element
18	hose
18′, 18″	hose section
19	electrode
20	control electronic means
21	pressure sensor
22	adjustment device
23	indication